

size/shape of the area of the eastern segment of the ebb delta that fronts Bogue Banks (Fig. 2, Appendix). The significance of the shape of the eastern shoal segment, that dictates much of the oceanfront shoreline changes, is addressed in a subsequent section of this report.

Inlet instability and ebb channel movement

Previous studies have shown that there have been dramatic changes in the direction and rates of movement of the throat section of the ebb channel since late 19th century (USACE 1938; Langfelder et al 1974; Baker 1977; Priddy and Carroway 1978; Hosier and Cleary 1982; USACE 1982 and 1983; Wells 1994; Cleary and Marden 1999; USACE 2000; and CS & E 2001). Backstrom (2000) in an unpublished study demonstrated that between 1938 and 1974 the ebb channel moved a net distance of 4,411 ft to the east. Net easterly migration also characterized the inlet between 1974 and 1999 when the channel moved 3,181 ft toward Bogue Banks. Several periods of westerly movement occurred between 1956 and 1959 and again between 1974 and 1983. Cleary and Marden (1999) in a regional study of North Carolina's inlet indicated that in the period 1871 to 1933 the channel moved a net distance of approximately 3000 ft in a westerly direction. A reversal of the net direction of movement occurred between 1938 and 1974 when the channel moved a net distance of approximately 3,280 ft toward Bogue Banks. Information germane to this study indicated that between 1974 and 1999 the net channel movement has been in an easterly direction at average rates of ~ 175 ft/yr (Backstrom 2000; CS & E 2000).

A study by the USACE (2000) documented a large variation in migration rates since 1985. Easterly channel migration rates ranged from 100ft/yr between November 1994 and March 1999 to 320 ft/yr during the period November 1985 to October 1989. The 15-year average rate of movement was 190 ft/yr. In the most recent and exhaustive study to date by CS & E (2001), net channel migration rates in an easterly direction were reported to range from 104 ft/yr during the period 1949 to 2001 to a high of 290 ft/yr between 1962 and 1974. Westerly migration rates of 154 ft/yr characterized the inlet between 1949 and 1962. According to CS& E (2001) the average net channel migration rate between 1974 and 2001 was 170ft/yr in an easterly direction.

Historic aerial photographs (Figs. 5 – 8) illustrate the changing configuration of the inlet, shoulders and adjacent oceanfront shorelines between 1938 and 2001.

Compilation of data derived from digitized aerial photographs during the conduct of this study indicates that during the period 1973– 2001, the ebb channel moved a net distance of 2,117ft in an easterly direction (Figs. 9 -13 and Figs. 1, 3 and 4, Appendix). Between December 1973 and September 1976 the ebb channel moved 1543 ft in a westerly direction toward Bear Island. Over the next five years, between September 1976 and September 1981, the channel continued to move toward Bear Island (west) a distance 352 ft (Figs. 9-11). Aerial photographs document the reorientation and repositioning of the ebb channel during a breaching event that occurred by mid 1975. A small spillover channel imaged on the April 1974 aerial photograph steadily enlarged, and by September of 1974 it was well established as a major feature (Figs. 5 and 6). The newly formed ebb channel became the dominant pathway for ebb flow by September 1976 (Fig. 6 B). Between 1976, when the ebb channel was in a shore normal configuration, and September 1981, the throat section of the ebb channel remained in approximately the same position (Fig. 4 and 6 C). Figure 4 illustrates that although the interior portion of the channel remained relatively stable, the channel's outer portion was deflected toward Bear Island.

The inlet (throat channel segment) began its eastward trek in 1981/82 while the seaward segment of the channel was still skewed toward Bear Island. Between September 1981 and February 1984, the throat section of the channel migrated rapidly to the east at a rate of 1,040ft/yr (Fig. 9). Figure 6 B and C and Figure 4 C in the Appendix illustrate that the large marginal flood channel on the eastern margin, imaged on the September 1981 and August 1982 photographs, became the site of an incipient secondary ebb channel by June 1984. During this period of initial reconfiguration of the inlet channels and shoals, a large complex spit began to develop on the Bogue Banks shoulder. Rapid spit growth on both shoulders resulted in severe constriction of the inlet throat. In February 1984 the IMW narrowed to 1,586 ft and the inlet baseline width reached its minimum value of 4,440 ft (Figs. 3, 6 C and D).

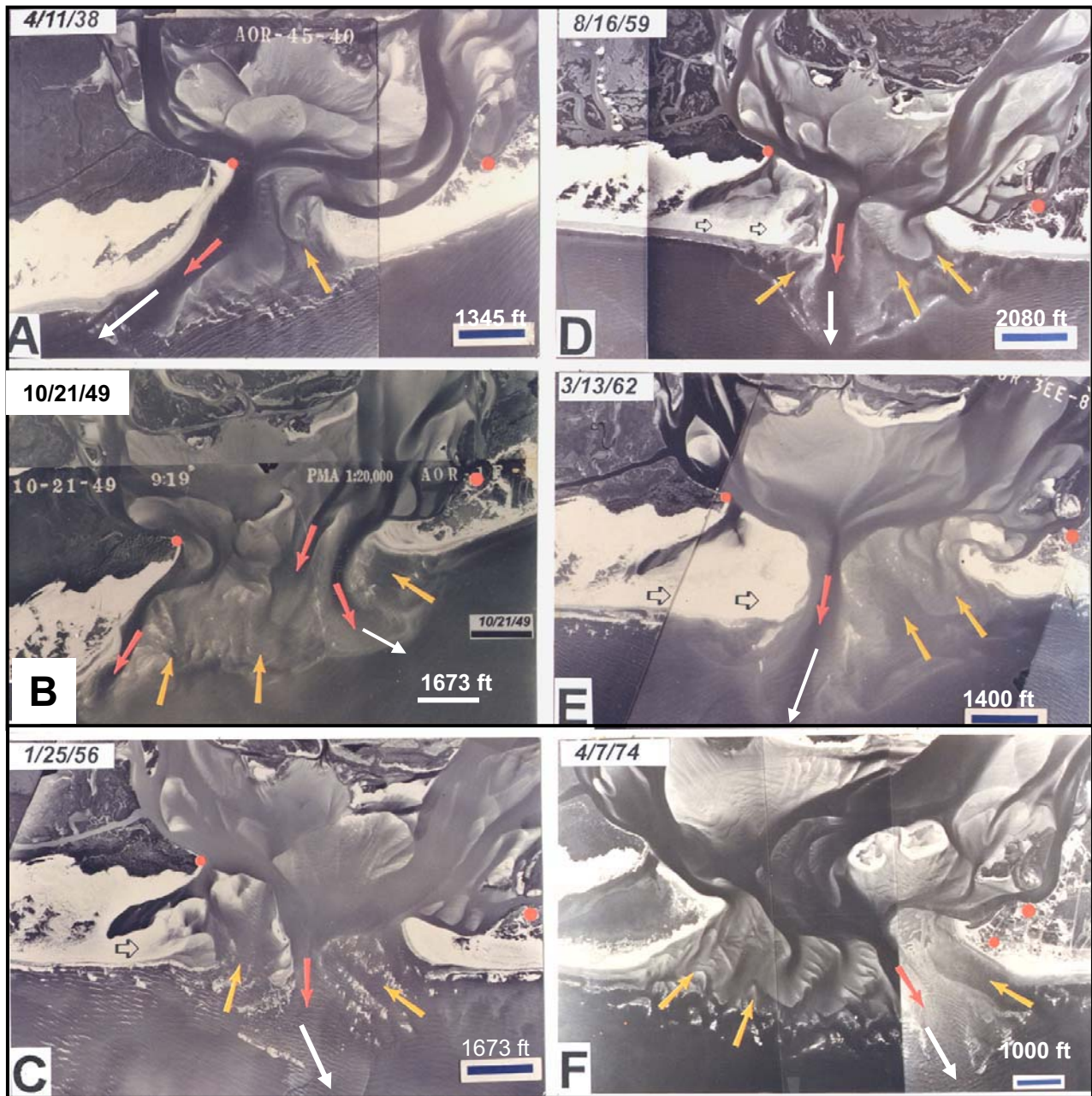


Figure 5. Historic aerial photographs A-F (4/11/38 – 4/7/74) depicting inlet and shoulder configurations. Note changing position and orientation of ebb channel, marginal flood channels, spit development on adjacent shoulders and ebb delta shape changes.